

TRENDS AND CHALLENGES TO THE DEVELOPMENT OF A LEAN CULTURE AMONG UK CONSTRUCTION ORGANISATIONS

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ABSTRACT

Lean construction efforts could prove to be highly rewarding for the UK construction industry, but there is a lack of experiential research to demonstrate how lean thinking principles are diffused and enacted by organizations to successfully attain the promised rewards. Building upon established conceptual frameworks, this study sought to identify how lean concepts are being enacted and reveal trends in the development of a lean culture among UK construction organisations. A theoretical framework, incorporating soft and hard aspects of lean was adopted for the research and formed the basis for a questionnaire survey. The study targeted practitioners in the UK construction industry and the data obtained was clustered into six classifications to allow trends and contrasting views to be determined.

Results revealed that although there seems to be positive trends in the development of a lean culture amongst UK construction organisations, but there is still a significant lack of understanding of how to successfully apply lean thinking principles to specific construction processes and activities. Analysis of the results also identified a number of structural and cultural barriers that are hindering progress towards the successful implementation of LC in the UK. The paper concludes with proposals to overcome barriers to the successful adoption of lean thinking and provides recommendations for future research.

KEYWORDS

Lean thinking, Culture, Collaboration, Barriers, Strategy for success

INTRODUCTION

The Construction industry, according to researchers, is seen as a slowly progressing industry with numerous problems and over the past 60 years the industry has commissioned several reports with the aim of reviewing its performance and suggesting means of improvement. The latest of these was the Egan report, 'Rethinking Construction', which was produced in 1998 to address concerns raised by clients engaging services of construction companies. At the heart of the Egan report was a desire to develop a change in the culture, style and management of the industry (Forbes & Ahmed 2011). The report reviewed case studies from around the world, where construction was attaining improvements, and amongst these were

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examples of lean thinking being applied successfully. Since 1998, efforts to encourage the use of lean concepts in construction across most geographical areas of the UK has been growing, as exemplified in seminars staged by the Construction Industry Research and Information Association (CIRIA) and Construction Productivity Network (CPN) (Johansen et al. 2002). These efforts have been expanded to include the Construction Lean Improvement Programme (CLIP) that was created by the BRE in 2003 to promote case studies developed by Construction Excellence. The establishment of the Lean Construction Institute UK (LCI-UK) and some Lean Construction (LC) consultancy and promotional companies has also helped to enhance awareness of LC principles. Some organizations and universities now offer LC education, which has been helpful in moving lean thinking into the mainstream of construction education.

Work by Common et al. (2000) examined the penetration of lean principles into large construction companies in the UK and found that there was a significantly less lean culture in UK construction companies than is professed. However, the study stopped short of identifying reasons for the discrepancy and recommended further research to investigate the transferability of lean principles from its roots in the manufacturing sector to the UK construction industry. Building on the methodologies and conceptual frameworks established by Common et al. (2000), but augmented by further studies conducted in the Netherlands (Johansen et al. 2002) and Germany (Johansen & Walter 2007), this research carried out a survey among UK construction organisations and professionals to identify how lean concepts have been disseminated and reveal trends and challenges to the development of a lean culture amongst construction organisations.

CONCEPTUAL FRAMEWORK

Lean thinking principles have been adapted from manufacturing sectors to the construction industry. It introduced to the construction industry the usage of new tools and techniques, which have a distinct difference when compared to those used in traditional practices. Many researchers identified the use of inappropriate tools as a barrier to the successful implementation of LC (Johansen et al. 2002; Bashir et al. 2010). However, it is important to realise that the lean philosophy has to be clearly understood in order for these tools and techniques to be optimally utilised (Bhasin & Burcher 2006). Focussing, only, on lean tools may improve performance but it will not lead to long term sustainable improvement (Hines et al. 2011) or yield to the full benefits of LC (Bashir et al. 2010). In their work Common et al. (2000) and Johansen et al. (2002) established a conceptual framework and identified four areas as being fundamental attributes of a Lean approach, namely: [1] Procurement, [2] Planning, [3] Control, and [4] Management concepts. Within each area they identified a number of tools and techniques that were seen as being instrumental for the realisation of LC.

Considering the progress made since the studies by Common et al (2000) and Johansen et al. (2002) were carried out, Johansen & Walter (2007) developed that conceptual framework to include eight areas (see Figure 2). Each area was associated with a number of tools and techniques which have been found to be most effective in improving conformance to lean principles. However, there have been vast developments made among the lean construction community since the study by Johansen & Walter (2007) was carried out. Recent studies emphasised the importance

of establishing a lean culture among the construction industry (Hines et al. 2011; Santorella 2011; Terry & Smith 2011). There has also been an improved understanding of the importance of using appropriate performance measurement systems (PMSs) to support the successful implementation of LC (Lantelme & Formoso 2000; Alarcón et al. 2001; Leong & Tilley 2008). Other studies have highlighted the value of linking the contribution of the lean concepts with the challenges of the triple bottom line of sustainability (Huovila & Koskela, 1998; CPN 2009). As a result lean construction implementation efforts have become more comprehensive.

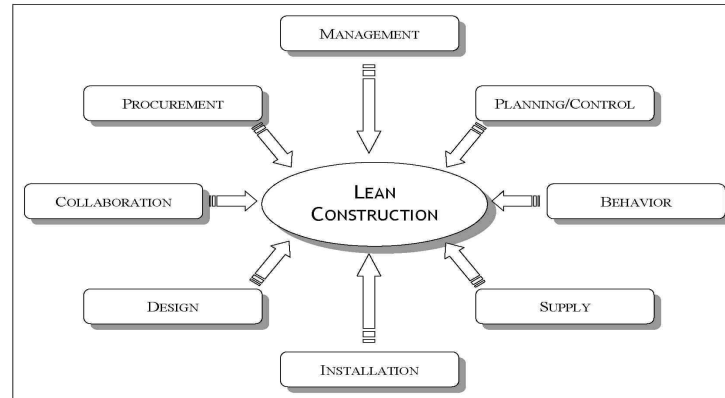


Figure 2: Updated Conceptual Framework (Johansen & Walter 2007)

Taking into account, the progress in lean construction to date, this study enhanced the framework established by Johansen & Walter (2007) to include hard and soft aspects of lean (Figure 3). These two aspects incorporated nine cornerstones which were recognized as being fundamental attributes of a lean approach. The soft aspects of lean comprised two cornerstones: [1] Lean culture (instead of just behavioural aspects) and [2] collaborative relationships; while the hard aspects of lean included the seven remaining corner stones of the framework, namely: [3] Performance measurement and evaluation; [4] Procurement; [5] Management concepts; [6] Planning and control; [7] Design, [8] Installation of design, and [9] Supply.

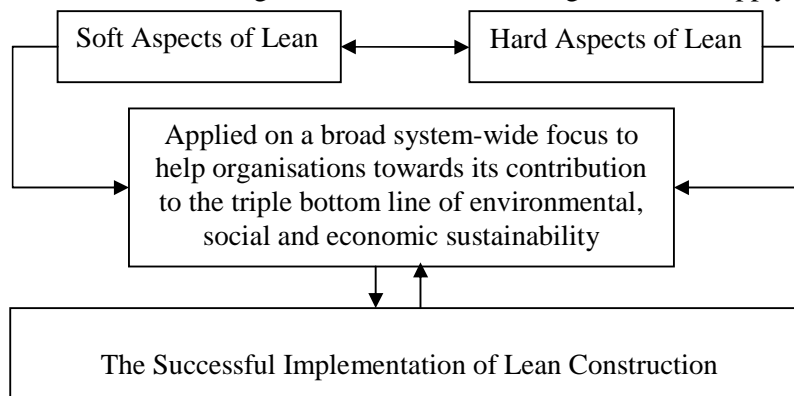


Figure 3: Enhanced Conceptual Framework for the study (Sarhan 2011)

RESEARCH METHOD

This research paper focusses on the soft aspects of lean and is part of a larger programme of study (Sarhan 2011). The study employed a mixed methods approach involving a questionnaire survey and semi-structured interviews to collect quantitative and qualitative data. This paper is based on findings from the questionnaire survey which included 36 questions and aimed to explore various aspects of the conceptual framework. The structure of the questionnaire was as follows:

- *Background details* (questions 1-9): To gain information about the participants and their organisations, so it can be used for secondary analysis.
- *Soft aspects of Lean* (questions 9 – 17): To evaluate the extent to which the lean culture is established within construction organisations in the UK. Also to identify the techniques used to facilitate the collaboration aspect of LC.
- *Hard Aspects of Lean* (questions 18 – 28): To identify and evaluate the techniques, tools and methods used by UK construction organisations for the implementation of LC. These cover the 7 remaining corner stones of the conceptual framework, namely: Procurement; Management concepts; Planning and control; Design, Installation of design, Supply, and Performance measurement and evaluation.
- *Outcomes of the successful implementation of LC* (questions 29 -33).
- *Challenges to the successful implementation of LC* (questions 34 and 35).
- *Invitation to follow up interviews* (question 36).

An invitation to complete the questionnaire was sent to 198 professional practitioners in the UK construction industry as well as a small sample of academics with an interest in LC (10 for a pilot study and 188 for the main study). Participants were selected from a number of professional groups that represent many of the professional organisations involved in the UK construction industry. The survey was hosted online for two weeks; and a total of 140 responses were received. This represents a response rate of 74.5%.

The results obtained indicated that the study was able to capture a well distributed mixture of professionals and organisations (see Tables 1 and 2). The largest proportion of the participants was for civil engineers (34%). In addition, more than half of the respondents (63%) were from practitioners holding managerial positions and with more than 10 years of experience in the industry.

Table 1: Distribution of the sample in percentage (Clustering of organisations)

[1] AAT in £ Millions			[2] Size of organisations		[3] Major Client		
1-100	100-1000	1000 +	<500 employ	>500 employ	Private	Public	Both
40%	31%	29%	46%	54%	14%	26%	60%

Table 2: Distribution of the sample in percentage (Clustering of individuals)

[1] Years of experience			[2] Current role (Managerial level)				[3] Level of education		
0-10	10-20	20+	Graduate /Junior	Middle Mgmt.	Senior Mgmt.	Other	Practical qualification	Bachelor's degree	Master's Degree & above
37 %	26 %	37 %	14%	26%	22%	37%	25%	36%	39%

RESEARCH RESULTS AND ANALYSIS

TRENDS IN THE DEVELOPMENT OF A LEAN CULTURE

Lean is a philosophy; without the philosophy tools are not nearly as effective (Bhasin & Burcher 2006). This requires creating a lean culture & developing collaborative relationships within organisations. For this reason, a set of questions were introduced to reveal trends in the development of a lean culture among UK construction organisations. The questions focussed on assessing and identifying three main areas: [1] Readiness of construction organisations for progressing along the lean journey; [2] Techniques practiced to help construction organisations to improve their collaborative relationships; and [3] Techniques set in place to help construction organisations to achieve the lean approach.

To consider the readiness of construction organisations for progressing along the lean journey, respondents were asked: [a] If there have been any attempts to provide formal lean training throughout their organisations (Lean capability learning); [b] To evaluate the performance of leaders within their organisations, in terms of motivating people; [c] To determine the level of attention devoted by team leaders to improving processes that are not processing major problems (Lean Commitment); and [d] To appraise the level of lean awareness of leadership teams obtained through formal training/induction. The measurement scale used for the analysis of the results was similar to that adopted by Terry & Smith (2011).

From the results obtained, it was found that construction organisations, in general, in terms of their readiness for progressing along the lean journey, are currently classified as 'Learning' organisations and that medium and large organisations are not very far behind from becoming 'Leading' organisations. Training is available for team leaders and project team members in the majority of large organisations. Most of their leadership teams have some knowledge of lean which they consider to be adequate for involvement of lean. However, according to their responses the overall lean capability within their organisations is patchy. Alternatively, small organisations were classified as 'Traditional' organisations. There is no formal lean training throughout the majority of small organisations (in terms of size and turnover). Any lean knowledge obtained is just by chance or through personal interest. Although, leaders of these small organisations were classified by the respondents as being generally able to motivate others and help teams to improve critical processes, the problem is that the majority of them are reluctant to any changes even though these changes may be able to improve the performance and increase the quality & productivity rates of their organisations. The majority of their leadership teams are

satisfied with achieving their intended objectives and do not need to know anything further on the lean construction subject.

A number of techniques recommended by Johansen & Walter (2007) were introduced to the participants to allow the study to identify the most common techniques used by organisations in order to facilitate their internal and external collaborative relationships (Table 3). Also, to see if organisations have experience with the Lean Project Delivery System (LPDS) developed by the LCI; which is considered to be a better way to design and build capital facilities (Ballard 2000).

Table 3: Techniques practiced to help construction organisations to improve their collaborative relationships

Collaboration techniques	AAT in £ Millions			Size of organisations		Major Client		Overall Results
	1-100	100-1000	1000+	<500 employees	>500 employees	Private	Public	
Long term contractual agreements, e.g. Partnering	59%	77%	74%	57%	76%	50%	71%	67%
Document management systems	52%	73%	71%	55%	69%	67%	47%	63%
Cross functional teams	27%	63%	62%	31%	61%	33%	47%	47%
Collaborative planning schedules (e.g. with subs or suppliers)	45%	43%	44%	41%	45%	42%	29%	45%
Project information systems	30%	47%	41%	29%	44%	42%	29%	37%
Integrated Project Delivery (IPD)	18%	40%	47%	16%	47%	21%	24%	33%
Lean Project Delivery System (LPDS)	9%	23%	29%	12%	25%	21%	24%	19%
Implement "all" the above	7%	23%	18%	10%	22%	4%	24%	16%

To identify the techniques set in place to help construction organisations to achieve the lean approach, respondents were asked to choose from a number of techniques which were recommended by a report published by CIRIA (CPN 2009).

Table 4: Techniques set in place to help construction organisations to achieve the lean approach

Fundamental Techniques	Overall %
Workplace Organisation - Create a safe & good workplace environment to complete the job	57%
Standardised Work - Identify best method to achieve quality, cost, time, etc., safely and consistently	54%
Data Analysis - Set targets, monitor and improve	52%
Problem Solving - Identify root-causes of problems	51%
Collaborative Planning	50%
Visual Management - Create clear process-oriented performance information to identify problems before they occur	46%
Process mapping - Identify who does what, when, why and how	42%
Work Sequence Analysis - identify wastes and risks, and consider logistics	39%
Implement "all" the fundamental techniques mentioned above	18%

All of these fundamental techniques mentioned in Table 4 are very essential and need to be practiced to enable construction organisations to progress along the lean journey sustainably (CPN 2009). Therefore, the data obtained from those who selected “all” of the fundamental tasks, shaded in Table 4, was clustered to allow comparisons to be determined (see Table 5).

Table 5: Clustering of organisations which have already set in place “all” the fundamental techniques required for proceeding along the lean journey sustainably

AAT in £ Millions			Size of Organisations		Major Client Sector	
1-100	100-1000	1000+	<500 employees	>500 employees	Private	Public
12%	27%	18%	10%	24%	9%	29%

CHALLENGES TO IMPLEMENTING LEAN CONSTRUCTION – STRUCTURAL AND CULTURAL BARRIERS

Several studies have been carried out in different countries worldwide to identify the barriers in implementing the LC approach. These barriers could affect the application process of LC and hinder the project performance, if not properly managed. By not understanding the factors that affect the successful implementation of LC, organizations will not be able to know what improvement efforts need to be made, where these efforts should be focused, or which efforts could obtain best results (Leong & Tilley 2008). For this reason, an extensive literature review was conducted to understand the possible barriers to the successful implementation of LC. Based on a thorough analysis and a systematic evaluation of how lean is disseminated and practiced among the UK construction industry, a number of barriers were merged and classified into ten categories as key barriers (Table 6). A question was then formulated and included in the electronic survey to: (i) See if the real world agrees with the study’s identification of the key barriers to the successful implementation of LC; (ii) Identify the most significant barriers according to its influence on the implementation of LC, based on the mean values obtained.

The respondents were asked to rate a range of barriers on a five-point Likert scale to indicate the level of influence, ranging from “5” equal to strongly agree to “1” equal to strongly disagree. All the key barriers identified by the study were recorded by responses in terms of influence with more than 50 per cent frequency. This suggests that the majority of the respondents agreed with the study’s identification of the key barriers to the successful implementation of LC. The data received from this question was entered into SPSS 19.0 software to evaluate its reliability using Cronbach’s Alpha coefficients. The coefficient obtained a value of 0.747 which indicates the “reliability” of the results as it is greater than the acceptable threshold (0.7) (Lam et al. 2007; Ab Rahman et al. 2011).

The mean values of the key barriers were then determined to indicate the level of influence of each of these barriers on the successful implementation of LC from the respondents’ perspective. If the mean value scored “4” or above to a particular barrier, then it would be classified as a significant barrier as such a score is a common threshold for significance used in previous research (Chan 2003; Lam et al. 2007)

Table 6: The significant barriers to the successful implementation of LC in the UK

Rank	ID	Key barriers	Mean	St. dev.
1	B3	Lack of adequate lean awareness/understanding	4.30	0.76
2	B7	Lack of top management commitment	4.06	0.94
3	B4	Culture & human attitudinal issues	4.04	0.86
4	B5	Time & commercial pressure	3.89	0.97
5	B1	Fragmentation & subcontracting	3.76	0.99
5	B2	Procurement & contracts	3.69	0.95
7	B9	Educational issues	3.58	1.03
8	B10	Lack of process based PMSs	3.54	0.98
9	B6	Financial issues	3.47	1.01
10	B8	Design/Construction dichotomy	3.34	1.18

Note: The shaded areas represent the significant barriers identified

As can be seen from Table 6, the mean values of three barriers, namely: B3, B4 & B7 exceeded the cut-off point (a mean score of 4.0 and above) and thus were considered as the significant barriers to the successful implementation of LC. It is also noticeable that these three barriers obtained the lowest standard deviations, which suggests that the participants were quite certain about these barriers more than all others. Further analysis of the results revealed that there was a strong level of agreement amongst all sub-classifications of the study that the lack of adequate lean understanding (B3) is the most significant barrier to the implementation of LC. All of these results should be seen positively; as they indicate that the professionals in the UK construction industry have the capacity for self-criticism, which was identified by Johansen & Walter (2007) as one of the fundamental behavioural aspects needed if a lean culture is to be established in an organisation.

CONCLUSION AND RECOMMENDATIONS

There is a lack of experiential research to demonstrate how lean thinking principles are diffused and enacted by organizations in the UK construction industry. To fill the gap in the existing body of knowledge, this study sought to identify how lean concepts have been disseminated and reveal trends and challenges to the development of a lean culture amongst UK construction organisations.

The study suggests that the situation in the UK construction industry in terms of developing collaborative relationships and partnerships can be perceived as progressive. A wide range of collaboration techniques, with reference to LC, have been utilised by UK construction organisation to improve their internal and external

collaborative relationships. However, it is important for construction organisations to realise that the use of partnering would become ineffective if the design work is separated from the construction process by contracting it out to external consultants with no follow up and integration.

In general, there seemed to be positive trends in the development of a lean culture among the construction organisations involved in the study, but the results obtained have revealed that in terms of putting lean thinking into practice there is still some way to go before a comprehensive lean approach is achieved. Only 18% of the respondents acknowledged that their organisations had set in place “all” the basic fundamental systems that could enable them to progress along the lean journey and a similarly small number were using a lean management system on projects.

There appears to be a number of structural and cultural barriers that are hindering the progress of UK construction organisations towards achieving the lean approach. This study identified a number of barriers to the successful implementation of LC and three were identified as significant, according to the participants’ opinion, namely: [1] Lack of adequate lean awareness and understanding; [2] Lack of top management commitment; and [3] Cultural & human attitudinal issues.

Construction organisations are recommended to alter their attentions from just focussing, only, on lean tools to also viewing lean as a philosophy and concentrating their efforts to the necessary lean culture implications. Additionally, these alterations need to be implemented on a broad system-wide focus and across the value chain to help organisations towards its contribution to the triple bottom line of sustainability. Large public sector client groups can offer a way forward as they seem to have made most progress towards LC (see Table 5) and may act as incentivises to the rest of the industry.

Finally, it is important to stress that this study provided a specific snapshot of opinions obtained from 140 professional practitioners in the UK construction industry as well as a small sample of academics with an interest in LC. A larger and more random sample is required to generalise and validate the findings of the study. Additionally, a qualitative research approach is suggested to investigate the underlying reasons for the low levels of lean awareness and understanding amongst practitioners in the UK construction industry as acknowledged by the participants of this study.

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